

Claims

1. Apparatus for shaping a pole-tip assembly of a recording transducer with a focused particle beam, said apparatus comprising
  - 5 a platform for receiving a multi-layer device including said recording transducer and for disposing said multi-layer device for interaction with said focused particle beam, said multi-layer device having
    - a first layer including a first structural element,
    - a second layer including a second structural element, and
    - 10 a shielding layer including a shielding element, said shielding element located between said first structural element and said second structural element,
    - said structural elements and said shielding element intersecting a geometrical surface that extends transversely to said first, second,
    - 15 and shielding layers, so that imaging at least a portion of said shielding element, at said geometrical surface, provides information that facilitates imaging said second structural element without imaging said first structural element,
    - means for scanning said focused particle beam over said geometrical surface at a selected section that includes at least a portion of said shielding
    - 20 element and that does not include said first structural element,
    - means for generating a first image signal of said portion of said shielding element responsive to interaction of said focused particle beam with said shielding element,
    - means for analyzing the first image signal of said portion of said shielding
    - 25 element to determine the location of said portion of said shielding element,
    - means for directing, responsive to said determined location of said portion of said shielding element, said focused particle beam to interact with said second structural element without substantially interacting with said first structural element,
    - 30 means for generating a second image signal responsive to interaction of said focused particle beam with said second structural element, and
    - processor means responsive to said second image signal for generating a milling signal representative of an instruction for applying said focused particle beam to a selected portion of said second structural element for milling said
    - 35 selected portion of said second structural element.

2. Apparatus according to claim 1 wherein said means for generating said second image signal further includes  
means for generating, responsive to said second image signal, a coordinate  
5 signal representative of an instruction for applying said focused particle beam to a selected portion of said second structural element for shaping said pole-tip assembly by milling said selected portion of said second structural element.
3. Apparatus according to claim 1 wherein said means for generating a first  
10 image signal and said means for generating a second image signal include a source of a focused particle beam.
4. Apparatus according to claim 1 wherein said means for generating a first  
image signal and said means for generating a second image signal include a  
15 camera element.
5. Apparatus according to claim 1 further including  
charge neutralization means for neutralizing a static electric charge on said  
recording transducer.  
20
6. A focused particle beam process for shaping a pole-tip assembly of a  
recording transducer, comprising the steps of  
disposing a multi-layer device forming said recording transducer on  
a platform for exposure to said particle beam, said multi-layer device having  
25 a first layer including a first structural element.  
a second layer including a second structural element, and  
a shielding layer including a shielding element located  
between said first structural element and said second structural element,  
said structural elements and said shielding element  
30 intersecting a geometrical surface that extends transversely to said first, second,  
and shielding layers, so that imaging at least a portion of said shielding element,  
at said geometrical surface, provides information that facilitates imaging said  
second structural element without imaging said first structural element.  
scanning said focused particle beam over said geometrical surface at  
35 a selected section that includes at least said portion of said shielding element and  
that does not include said first structural element.

generating a first image signal of said portion of said shielding element responsive to interaction of said focused particle beam with said portion of said shielding element,

analyzing the first image signal of said portion of said shielding element to determine the location of said portion of said shielding element,

directing, responsive to said determined location of said portion of said shielding element, said focused particle beam to interact with said second structural element without substantially interacting with said first structural element,

generating a second image signal responsive to interaction of said focused particle beam with said second structural element, and

generating, responsive to said second image signal, milling signals representative of an instruction for applying said focused particle beam to a selected portion of said second structural element for shaping said pole-tip assembly by milling said selected portion of said recording transducer.

7. Process according to claim 6 wherein said step of generating said second image signal further includes

generating, responsive to said second image signal, a coordinate signal representative of an instruction for applying said focused particle beam to a selected portion of said second structural element for shaping said pole-tip assembly by milling said selected portion of said recording transducer.

8. A process according to claim 6 including the further step of providing charge neutralization means for neutralizing charge on said recording transducer.

9. A process according to claim 7 wherein said step of generating a coordinate signal includes detecting an edge of said second structural element and generating an edge signal representative of a location of said edge of said second structural element relative to said focused particle beam.

10. A process according to claim 6 wherein said step of generating milling signals includes generating, as a function of said second image signal, a presentation signal representative of a pattern presentation of said second structural element.

11. A process according to claim 10 wherein said step of generating milling signals includes comparing said presentation signal to a pattern signal representative of a select second structural element topography.
- 5
12. A process according to claim 11 wherein said step of comparing said presentation signal to said pattern includes determining an etching pattern signal representative of one or more areas to etch from said second structural element to conform said second structural element substantially to said select second
- 10 structural element topography.
13. A process according to claim 12 wherein said step of determining an etching pattern signal includes determining a minimum etching-time signal representative of a milling pattern having a minimum length of time for
- 15 conforming said second structural element substantially to said select second structural element topography.
14. A process according to claim 12 wherein said step of determining an etching pattern signal includes determining a minimum etching-area signal
- 20 representative of a milling pattern having a minimum area to be removed for conforming said second structural element substantially to said select second structural element topography.
15. A process according to claim 10 wherein said step of generating milling
- 25 signals includes comparing said presentation signal to a plurality of said pattern signals and selecting one of said pattern signals as a function of said comparison.
16. A process according to claim 6 wherein said step of generating milling signals includes generating an instruction signal representative of a location for
- 30 deflecting said particle beam.
17. A process according to claim 6 wherein said portion of said shielding element is a portion of said shielding element closest to said second structural element.

18. Apparatus for shaping a pole-tip assembly of a recording transducer with a focused particle beam, said apparatus comprising
- a platform for receiving a multi-layer device including said recording transducer and for disposing said multi-layer device for interaction with said
  - 5 focused particle beam, said multi-layer device having
    - a first layer including a first structural element,
    - a second layer including a second structural element, and
    - a shielding layer including a shielding element, said
  - shielding element located between said first structural element and said second
  - 10 structural element,
    - said structural elements and said shielding element
    - intersecting a geometrical surface that extends transversely to said first, second,
    - and shielding layers, so that imaging at least a portion of said shielding element,
    - at said geometrical surface, provides information that facilitates imaging said
    - 15 second structural element without imaging said first structural element,
    - means for scanning said focused particle beam over said geometrical
    - surface at a selected section that includes at least a portion of said shielding
    - element and that does not include said first structural element,
    - means for generating a first image signal of said portion of said shielding
    - 20 element responsive to interaction of said focused particle beam with said
    - shielding element, and for generating a second image signal responsive to
    - interaction of said focused particle beam with said second structural element.
    - means for analyzing said first image signal of said portion of said shielding
    - element to determine the location of said portion of said shielding element.
    - 25 means for directing, responsive to said determined location of said portion
    - of said shielding element, said focused particle beam to interact with said second
    - structural element without substantially interacting with said first structural
    - element, said interaction of said focused particle beam with said second structural
    - element resulting in said second image signal, and
    - 30 processor means responsive to said second image signal for generating a
    - milling signal representative of an instruction for applying said focused particle
    - beam to a selected portion of said second structural element for milling said
    - selected portion of said second structural element.